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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H03K 17/968, G02B 26/02, 26/08

A1

(11) International Publication Number: WO 95/28036

(43) International Publication Date: 19 October 1995 (19.10.95)

(21) International Application Number: PCT/GB95/00781

(22) International Filing Date: 5 April 1995 (05.04.95)

(30) Priority Data:
9406741.0 6 April 1994 (06.04.94) GB

(71) Applicant *(for all designated States except US)*: ABBOTSBURY SOFTWARE LIMITED [GB/GB]; West Yard Barn, West Street, Abbotsbury, Dorset DT3 4JT (GB).

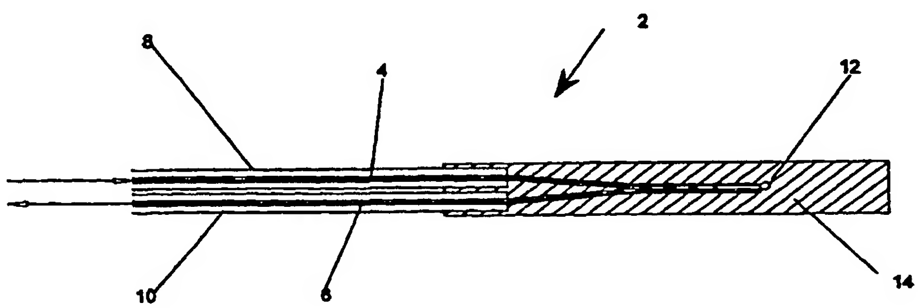
(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: SNAPE, Timothy, Richard [GB/GB]; 4 Back Street, Abbotsbury, Dorset DT3 4JP (GB).

(74) Agent: JONES, Graham, Henry; Graham Jones & Company, 77 Beaconsfield Road, Blackheath, London SE3 7LG (GB).

(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).

Published
With international search report.

(54) Title: AN OPTICAL SWITCH



(57) Abstract

An optical switch (2) comprising reflector means (12) which is movable from a first position to a second position and from the second position to the first position, the first position being one in which the reflector means (12) receives transmitted light and reflects it, and the second position being one in which the reflector means (12) does not reflect the transmitted light. The reflector means (12) may be mounted by a deformable optically clear medium. The optical switch (2) may include fibre optic means for the passage of transmitted light and reflected light.

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AN OPTICAL SWITCH

This invention relates to an optical switch.

Electrical switches are well known but there are often situations where it is not appropriate to use an electrical switch. Thus, for example, in a gaseous environment, it is often not safe to use an electrical switch in case activation of the switch causes an explosion. Also, electrical switches cannot be used under water, unless they are especially made at high cost and have protective enclosures.

It is an aim of the present invention to reduce the above mentioned problem by providing an optical switch.

Accordingly, the present invention provides an optical switch comprising reflector means which is movable from a first position to a second position and from the second position to the first position, the first position being one in which the reflector means receives transmitted light and reflects it, and the second position being one in which the reflector means does not reflect the transmitted light.

The optical switch of the present invention does not create sparks in the manner often associated with electrical switches. Also, the optical switch of the present invention can be used in over pressure environments such as under water, or in under pressure

environments such as space. The optical switch can easily be produced at low cost. The optical switch is robust and may be of simple construction. The optical switch can be made of non-corrosive materials.

Preferably, the reflector means is mounted by a deformable optically clear medium such that the position of the reflector means is able to be changed in response to an application of an external pressure. The reflector means may be mounted in or on the deformable optically clear medium. The external pressure may be applied directly or indirectly to the deformable optically clear medium.

The mounting of one or more reflector means in or on a deformable optically clear medium such for example as an appropriate elastomer has the following advantages.

(a) The optical switch is simple to manufacture so that it is optically efficient.

(b) The optical switch is highly robust and potentially insensitive to environmental influences.

(c) The optical switch is not mechanical and is therefore less likely to break.

(d) The optical switch is cheap and easy to manufacture.

(e) The optical switch is appropriate for scaling down in size and can thus be made extremely small.

(f) The optical switch is such that a micro-miniature variant may be manufactured by a printing process, and therefore the optical switch is appropriate for being produced in very high volumes, for example tens of millions.

The advantages (a) and (b) above are especially important as the optical efficiency determines over what distance the optical switch can be used, and also the power levels required to generate a light source bright enough for there to be an observable switching action. If mirrors or prisms are used mounted on mechanical gimbals which rotate or move to create a switch response, then such arrangements have the following disadvantages.

(a) They are difficult to manufacture in order that they are optically efficient.

(b) They are prone to damage from environmental influences.

(c) They are mechanical and therefore prone to breaking.

(d) They are expensive to manufacture.

The optical switch may include a discontinuity in the deformable optically clear medium such that a linear force applied to the deformable optically clear medium results in an observable displacement of the reflector means.

The optical switch may include a discontinuity in the deformable optically clear medium such that the discontinuity results in a displacement of the reflecting surface in response to external stimuli. The external stimuli may be, for example, pressure or temperature.

Usually, the reflector means will be such that the first position of the reflector means corresponds to an on position of the optical switch, and the second position of the reflector means corresponds to an off position of the optical switch. The opposite arrangement may be employed if desired.

The optical switch may be one in which the reflector means is such that in the second position, the reflector means does not receive the transmitted light. If desired the reflector means may be such that in the second position, the reflector means receives the transmitted light but does not reflect it for onward transmission and, for example, reflects it at some angle.

Preferably, the optical switch includes fibre optic means for the passage of transmitted light and reflected light.

Usually, the fibre optic means will comprise at least two separate optical fibres, one for the transmitted light and one for the reflected light. Such an arrangement separates the transmitted light from the received light, and helps to maintain the transmitted light and the received light at optimum values. If desired, the fibre optic means may be one single optical fibre having a first longitudinal portion for the transmitted light and a second longitudinal portion for the reflected light. Thus, for example, with a single optical fibre, half of the optical fibre in the longitudinal direction may be for the transmitted light and half the optical fibre in the longitudinal direction may be for the reflected light. Alternatively, if desired, a single optical fibre may be used in an arrangement where the reflected light can be separately discriminated from the transmitted light.

The reflector means may be at least one spherical reflecting ball, for example a ball bearing. Other types of reflector means may be employed. Thus, for example, the reflector means may be any suitable and appropriate type of reflecting surface including at

least one mirror. Various types of mirrors may be employed.

The optical switch works by a pressure actuation on the reflector means which may reflect light back to a sensor. The optical switch may be configured so that a light source also acts to illuminate the optical switch for the user. The illuminating source may be the same source as the transmitted light source. Hence the optical switch will be constantly illuminated. Alternatively, the illuminating source may be separate from the transmitted source, thereby making the illuminating source controllable. Thus, for example, the optical switch may be installed on a vehicle dashboard and the optical switch will always be illuminated. In other words, the optical switch becomes a self-illuminating switch.

The optical switch may be an on/off switch, for example having two fibre optic cables as described above, one carrying an afferent signal and the other carrying an efferent signal. The afferent signal is light transmitted from the light source to the optical switch. The efferent signal is light reflected from the optical switch back to a light sensor. Normally the afferent and efferent signals will be carried to and from the optical switch using optical fibres. The optical fibres however may not be present, in which case

the afferent signal will come directly from a light source to the optical switch and the efferent signal will be reflected back directly to a sensor. As an alternative to an on/off switch, the optical switch may be a rotary switch. The rotary switch may be based on one afferent optic source with an array of efferents. The afferent and efferent optical fibres may be positioned such that an external force would cause one or more efferents to be triggered. The efferent source triggered would depend on the direction in which the external force came from.

An off-centre rotary mechanism may be used with the rotary switch such that the off-centre rotary mechanism applies a directional force. The direction of the force would depend upon the amount of rotation applied to the rotary mechanism. The rotary switch may have four afferents and four efferents. Other arrangements may however be employed.

The optical switch may be for a wide variety of uses so that, for example, the optical switch may be in the form of a linear slider or a joystick. The optical switch is designed as appropriate using different configurations of optical fibres.

The optical switch may be arranged to be sensitive to other influences. Thus, for example, by incorporating some discontinuity into the optical

switch, for example in the deformable optically clear medium, it is possible to design the optical switch to be sensitive to other influences. The discontinuity may be a gas filled bubble. In this case, the result is an optical switch that is sensitive to pressure and temperature variations. Similar variations may be designed to create switches sensitive to other influences such for example as tilt, radiation, ambient light and shock. Other arrangements may be devised whereby the reflecting means is changed under the influence of external stimuli. Thus, for example, magneto-optical reflectors may allow the optical switch to be turned on/off using a magnetic field.

As indicated above, the optical switch lends itself to micro-miniaturisation. Thus the optical switch may be a microswitch. The optical switch may be constructed as the termination of a single optical fibre. Micro miniaturised switches of this type lend themselves to high volume manufacture and can easily be incorporated into any appliance.

The optical switch may be one which includes a resilient material, whereby the resilient material is deformable in order to cause the movement of the reflector means. The resilient material may be deformed by any suitable and appropriate means such for example

as by hand or by a person's teeth. The resilient material may be optically non-transparent.

Alternatively, the reflector means may be mounted adjacent to a magnet means whereby the magnet means is able to cause the movement of the reflector means. In this case, the reflector means will usually be made of a magnetically responsive material. The reflector means may be so mounted that it is surrounded by magnet means in the form of an array of individual magnets.

The optical switch may include a light source and diffusion means such that the light source illuminates the optical switch.

The optical switch may include transmitter means and receiver means.

The reflector means may be positioned using magnets.

Embodiments of the invention will now be described solely by way of example and with reference to the accompanying drawings in which:

Figure 1 shows a first optical switch in an on condition;

Figure 2 shows the optical switch of Figure 1 in an off condition;

Figure 3 shows a second optical switch in an on condition;

Figure 4 shows the optical switch of Figure 3 in an off condition;

Figure 5 shows a diver's mouthpiece provided with two of the optical switches as shown in Figure 3;

Figure 6 is an end view of the diver's mouthpiece as shown in Figure 5;

Figure 7 shows the optical switch of Figure 3 connected to a transmitter and a receiver;

Figure 8 shows a third optical switch in an on condition;

Figure 9 shows a fourth optical switch in a sensing circuit and in an on condition;

Figure 10 shows the fourth optical switch of Figure 9 in an off condition;

Figure 11 shows how multiple switches may be run from the same light circuit;

Figure 12 shows a key pad configuration utilising optical light switches;

Figure 13 shows a fifth optical switch;

Figure 14 shows the optical switch of Figure 14 in use;

Figure 15 shows a sixth optical switch;

Figure 16 shows the optical switch at Figure 15 in use;

Figure 17 shows the optical switch of Figure 15 but in operation;

Figure 18 shows the optical switch of Figure 17 but actuated;

Figure 19 shows a seventh optical switch;

Figure 20 shows the optical switch of Figure 19 in use;

Figure 21 shows an eighth optical switch;

Figure 22 illustrates a cap part of the optical switch of Figure 21;

Figure 23 is a view from the bottom as shown in Figure 22;

Figure 24 shows the base part of the optical switch of Figure 21;

Figure 25 is a view from the top as shown in Figure 24;

Figure 26 shows a ninth optical switch;

Figure 27 shows the optical switch of Figure 26 in use;

Figure 28 shows a tenth optical switch; and

Figure 29 shows an eleventh optical switch.

Referring to Figures 1 and 2, there is shown an optical switch 2 comprising fibre optic means in the form of two separate optical fibres 4, 6. The optical fibres 4, 6 are protected by sheathing 8, 10 respectively. The optical switch 2 further comprises reflector means in the form of a ball bearing 12. The

ball bearing 12 is positioned adjacent the end of the optical fibres 4, 6 as shown in Figures 1 and 2.

The ball bearing 12 and the associated ends of the optical fibres 4, 6 are held in a housing 14 which is made of a resilient material so that it can be squeezed or bent as shown in Figure 2 by the arrows 16.

Figure 1 shows the ball bearing 12 in a first position in which it receives transmitted light along the optical fibre 4 and reflects the light as transmitted light along the optical fibre 6. Figure 2 shows the housing 14 being squeezed to cause the ball bearing 12 to move to a second position. In this second position, the ball bearing 12 receives the transmitted light passing along the optical fibre 4 but it does not reflect the light along the optical fibre 6.

Figures 3 and 4 show a second optical switch 2. For ease of comparison and understanding, similar parts as in Figures 1 and 2 have been given the same reference numerals. In Figures 3 and 4, it will be seen that the ball bearing 12 acts upon a concave reflector 18. Figure 3 shows the concave reflector 18 in a first position in which it receives the transmitted light passing along the optical fibre 4 and reflects this light along the optical fibre 6. Figure 4 shows the housing 14 starting to be squeezed and the ball bearing 12 having been moved longitudinally towards the optical

fibre 4, 6 by the squeezing. This movement of the ball bearing 12 has caused the reflector 18 to deform as shown so that transmitted light passing along the optical fibre 4 is not reflected back along the optical fibre 6.

Figures 5 and 6 show two of the optical switches 2 shown in Figure 3 located in a diver's mouthpiece 20. The mouthpiece 20 comprises two bite portions 22, 24 which are adapted to be bitten between the diver's teeth in the diver's mouth. The bite portions 22, 24 each contain one of the optical switches 2 as shown. The bite portions 22, 24 extend into a neck portion 26 which is provided with ribs 28 as shown. A jubilee clip (not shown) locates over the neck portion 26 between the ribs 28 and connects the neck portion 26 to a hose (not shown) on an air supply. Air is then able to pass into the diver's mouth via a bore 30 in the neck portion 26.

Referring now to Figure 7, the optical switch 2 of Figure 3 is shown with the optical fibres 4, 6 having their sheathing 8, 10 and being connected to transmitter means in the form of a transmitter 32 and receiver means in the form of a receiver 34. The connection of the transmitter 32 to the optical fibre 4 is effected by an optical connector 36. Similarly, the connection of the optical fibre 6 to the receiver 34 is effected using an optical connector 38.

Figure 8 shows a third optical switch 2 which is similar to the optical switch 2 shown in Figure 3 and in which similar parts have been given the same reference numerals for ease of comparison and understanding. In Figure 8, it will be seen that only one optical fibre 4 is employed. This optical fibre 4 is such that one half of the optical fibre 4 in the longitudinal direction is able to receive transmitted light shown by the arrow 40, and the other half of the optical fibre 4 in a longitudinal direction is able to receive transmitted light as shown by the arrow 42. The receiving and the reflecting of the light is still effected by the reflector 18. When the housing 14 is squeezed or otherwise deformed, then the ball bearing 12 will move forwardly in the same manner as shown in Figure 4 to prevent the transmitted light being reflected.

Figures 9 and 10 show a fourth optical switch 2 which is similar to the optical switch 2 shown in Figures 1 and 2. Similar parts have thus been given the same reference numerals for ease of comparison and understanding. In Figures 9 and 10, the optical fibres 4, 6 are protected by a common sheath 44. Light is provided via the light source shown for the purposes of illustration as a diode 46. The light path from the diode 46 is shown as a light path 48. An electrical switch shown for the purposes of illustration as a

transistor 50 is provided as shown. When the sheath 44 is squeezed as shown by arrows 16, then the light path is broken and this breaking of the light path can be detected via the transistor 50 which can then change electrical state as required to provide an electrical switching action. Figure 9 shows the condition when current is flowing and Figure 10 shows the condition when no current is flowing.

Figure 11 shows three of the optical switches 2 being run from the the same light circuit 52. More than three of the optical switches 2 may be provided if desired.

Figure 12 shows a key pad configuration 54. Similar parts as in Figure 9, 10 and 11 have been given the same reference numerals for ease of comparison and understanding. It will be seen that the transistors 50 are disposed in X and Y alignment. The correlation between the X transistors 50 and the Y transistors 50 determines which key pad 56 has been pressed. The use of the optical switches in key pads as shown in Figure 12 may be especially advantageous in applications where radio frequency interference and/or noise are required to be minimised or eliminated.

The optical switch 2 can easily and simply be made. Thus, for example, the switch ends of the optical fibres 4 can be potted inside a rubber elastomer which

precisely locates the ends of the optical fibres. The ball bearing 12 can then be held in position with more elastomer which may be of the same or a different elastomeric material to that holding the optical fibres 4, 6.

Figure 13 shows an optical switch 58 comprising an optically clear window 60 which may be made from glass, perspex or quartz. The optical switch 58 has a body 62 which may be made from a plastics material, a metal or any other suitable and appropriate type of material. Inside the body 62 is an optically clear elastomer 64, which is a rubbery type of material. The optical switch 58 has reflector means in the form of a concave mirror 66. The optical switch 58 also includes displacer means 68 for causing the concave mirror 66 to rotate when a downward pressure is placed on the concave mirror 66. The body 62 is provided with a screw threaded portion 70 for enabling the optical switch 58 to be screwed into position. A rubbery nmaterial in the form of an opaque elastomer 72 closes the body 62 as shown. The opaque elastomer 72 does not let any light through.

Figure 14 shows the optical switch 58 of Figure 13 screwed into equipment 74. As can be seen from Figure 14, a fibre optic cable 76 carries light from a light source 78 to the optical switch 58. A fibre optic cable

80 carries light from the optical switch 58 to a light sensor 82.

In Figure 15 - 26, similar parts as in Figures 13 and 14 have been given the same reference numerals for ease of comparison and understanding.

In Figure 15, the displacer means 68 is differently configured to the displacer means shown in Figure 13. In Figure 15, the displacer means has the effect of causing the concave mirror 66 to rotate when a downward pressure is applied on the concave mirror 66. Thus the displacement effect in Figure 15 is the same as the displacement effect in Figure 13 but just achieved a different way.

Figure 16 is like Figure 14 but shows the optical switch 58 of Figure 15 in the equipment 74.

Figure 17 shows the optical switch 58 of Figure 15 but in operation. In Figure 17, the light source 78 is shown symbolically as a lamp. The light sensor 82 is shown symbolically as an eye. The concave member 66 is positioned such that light incident from the light source 78 is focused on to the light sensor 82.

Figure 18 shows the optical switch 58 of Figure 17 but in an actuated condition. In Figure 18, the opaque elastomer 72 has been deformed as shown which in turn has deformed the optically clear elastomer 64, also as shown. The displacer means 68 has been moved and this

has caused the concave mirror 66 to be displaced with a rotary motion. This causes the reflected light to be focused differently so that the reflected light does not fall on the sensor 82 and thus the optical switch 58 does not operate the sensor 82 as it was in Figure 17. The opaque elastomer 72 is deformed by the application of pressure, for example from a person's hand or other part of their body.

Figure 19 shows an optical switch 58 which is like the optical switch shown in Figure 13 but which includes a light guide 84 which carries light along its length. A light guide terminator 86 releases light. An elastomeric compound or other suitable and appropriate material 88 is employed and is such that it glows in response to light transmitted along the light guide 84 and the light guide terminator 86. Thus the optical switch 58 shown in Figure 19 is a self-illuminating switch.

Figure 20 shows the optical switch 58 of Figure 19 in use in equipment 74. Figure 20 is similar to Figure 14 but Figure 20 also shows a light source 90 for providing light for the light guide 84. Figure 20 also shows a fibre optic or other light guide 92 for carrying light from the light source 90 to the light guide 84.

Figure 21 shows a rotary optical switch 58. In Figure 21, there is shown a fibre pair 94 which is one

of four fibre pairs 94 containing a transmit fibre and a receive fibre. Reflector means in the form of a reflecting surface 96 is such that when aligned light arrives along a fibre pair 94, the light will be reflected back down the receive fibre in the fibre pair 94. Figure 21 also shows location and positioning means 98. The location and positioning means 98 provides a way of keeping the switch base 100 and the switch cap 102 correctly aligned with each other. Other types of location and positioning means may be employed.

In Figure 21, there is also shown a location recess 104 which is one of four such location recesses 104. A location mechanism 106 is employed and, as can be seen, this location mechanism 106 comprises a spring 108 and a ball bearing 110. Damper means 112 are employed to smooth rotational motion. The rotary optical switch 58 has four fibre pairs 94, four location recesses 104, and one reflecting surface 96. However, any number of fibre pairs 94, location recesses 104 and reflecting surfaces 96 may be employed.

Figures 22 and 23 show in more detail the shape of the switch cap 102 used in the optical switch 58 of Figure 21. The switch cap 102 and/or the switch base 104 can be rotated.

Figures 24 and 25 show in more detail the switch base 100 employed in the optical switch 58 of Figure 21.

Figures 24 and 25 enable the precise shape and construction of the optical base 100 more easily to be appreciated. Figure 25 shows the four fibre pairs 94 and in each pair, one fibre is a transmit element and the other fibre is a receive element. In Figure 24, one complete fibre pair 94 is shown, positioned between two fibre pairs 94 with only one fibre of each pair showing.

Referring now to Figure 26, there is shown an optical switch 58 which is like the optical switch shown in Figure 13 except that in Figure 26 the displacer means 68 is in the form of a gas filled pocket. This enables the optical switch 58 shown in Figure 26 to be sensitive to pressure and temperature variations.

Figure 27 shows the optical switch 58 of Figure 26 installed in equipment 74.

Figure 28 shows a miniaturised optical switch 114 positioned as a terminator to a single optical fibre 116. Figure 28 shows reflector means in the form of a reflecting surface 118 which is positioned such that it optimally reflects light back down the optical fibre 116. A protective elastomeric layer 120 is employed. This protective elastomeric layer 120 does not allow light through it and it physically protects the optical switch 114. However, pressure applied to the surface of the protective elastomeric layer 120 is still able to cause a deformation or movement of the reflecting

surface 118 sufficient to cause a detectable variation in the amount of light reflected back down part 122 of the fibre optical fibre 116 which may be in the form of a fibre optical cable.

Figure 28 also shows the use of an optically clear elastomeric material 124, and a cut end 126 of the optical fibre 116. The centre 122 of the optical fibre is the part through which light is channelled. Optical fibre cladding 128 is employed to physically protect the optical fibre 116.

Figure 29 shows a miniaturised optical switch 114 but having two light channels, one light channel 130 being used to send light, and the other light channel 132 being used to receive light. The reason for using more than one optical fibre 122 and in this case more than one light channel, is to make it easier to discriminate the received light from the transmitted light. In other words, it is easier to sense switching actions.

It is to be appreciated that the embodiments of the invention described above with reference to the accompanying drawings have been given by way of example only and that modifications may be effected. Thus, for example, the optical switch 2 of the present invention may be used in a wide variety of environments where it is not desired to use electricity. For example, if the

optical switch 2 is being used in sea water, it will not tend to corrode to the same extent that electrical switches do. The optical switch 2 may also be used in space or in any environment where there may be variation in ambient pressure. Operation of the optical switch 2 as shown in Figures 5 and 6 may be especially convenient for divers working in cold water and with gloves on, where it is difficult to operate small switches by hand. The optical switch may be of other designs than those shown.

If desired, the reflector means, for example the ball bearing, can be surrounded by magnets during construction in a silicon compound. This will ensure that the ball bearing reflector stays in an optimal position for reflecting the light. Alternatively, the magnets could be used to move the reflector means to the on or off position. In both of these embodiments, a magnetic reflector means will be required. The silicon compound is a resilient material that can be squeezed enough to push to reflector means, for example the ball bearing, for the reflection of light. The silicon compound can be replaced with other similar acting and suitable resilient materials.

The optical switch can be made to be such that in the second switch position, the reflector means, for example the ball bearing, corresponds to the off

position where no light is transmitted. This can be achieved by using a reflective ball bearing. The second position may alternatively correspond to the off position where the light is bent such that the reflected light does not pass along the fibre optic link. This can be achieved using a concave reflector in conjunction with deformer means such for example as a ball bearing. Thus, when the optical switch is squeezed, the deformer means causes the concave reflector to deform, so that the light is reflected at an angle, and not back down the fibre optic cable. The on or off positions can be easily changed if desired. As indicated above, other types of reflector can be used instead of a ball bearing reflector.

The fibre optic connections of the optical switch may comprise two fibre optic cables, one for the transmission of the light, and the other to receive the reflected light, or one fibre optic cable can be used having two channels, one for the transmission and one for the reception of light.

The optical switch will not tend to corrode as electrical switches do, and therefore the optical switch may be used in environments where normal electrical switches might corrode a lot, for example on a ship where sea air could speed up the corrosion process.

The optical switch can be used in many different environments, for example under water where lack of corrosion and ease of use are beneficial. The optical switch can also be used in areas which are flammable to sparks that ordinary switches produce. The optical switch can be used with a person's teeth for applications where the person is unable to, or cannot, use his or her hands. The optical switch may also be used in industrial environments that are unsuitable for electrical switches, for example in a messy environment where the optical switch could have a longer lifetime than an electrical switch because the electrical switch would fail due to dirt and grime.

The optical switch may be battery operated. If desired, the optical switch may be used as an on/off switch in a battery. Power connectors may then be provided so that the battery connectors would be sealed from the environment when the battery is connected to the appliance it is supplying power to. An optical switch could be built into a battery, for example in the enclosure of the battery. The benefit would be that the battery connectors and the mechanism to turn the battery on and off need not be sealed from the environment. This would reduce cost of the enclosure for battery powered equipment. This would result in battery powered

equipment that was less prone to damage due to ingress of moisture.

CLAIMS

1. An optical switch comprising reflector means which is movable from a first position to a second position and from the second position to the first position, the first position being one in which the reflector means receives transmitted light and reflects it, and the second position being one in which the reflector means does not reflect the transmitted light.

2. An optical switch according to claim 1 in which the reflector means is mounted by a deformable optically clear medium such that the position of the reflector means is able to be changed in response to an application of external pressure.

3. An optical switch according to claim 2 in which the reflector means is mounted in or on the deformable optically clear medium.

4. An optical switch according to claim 2 or claim 3 and including a discontinuity in the deformable optically clear medium such that a linear force applied to the deformable optical clear medium results in an observable displacement of the reflector means.

5. An optical switch according to claim 2 or claim 3 and including a discontinuity in the deformable optically clear medium such that the discontinuity results in a displacement of the reflecting surface in response to external stimuli.

6. An optical switch according to any one of the preceding claims in which the reflector means is such that the first position of the reflector means corresponds to an on position of the optical switch, and the second position of the reflector means corresponds to an off position of the optical switch.

7. An optical switch according to any one of the preceding claims in which the reflector means is such that in the second position, the reflector means does not receive the transmitted light.

8. An optical switch according to any one of the preceding claims and including fibre optic means for the passage of transmitted light and reflected light.

9. An optical switch according to claim 8 in which the fibre optic means comprises at least two separate optical fibres, one for the transmitted light and one for the reflected light.

10. An optical switch according to claim 8 in which the fibre optic means is one single optical fibre having a first longitudinal portion for the transmitted light and a second longitudinal portion for the reflected light.

11. An optical switch according to any one of the preceding claims in which the reflector means is at least one spherical reflecting ball.

12. An optical switch according to any one of claims 1 to 10 in which the reflector means is at least one mirror.

13. An optical switch according to any one of the preceding claims and which includes a resilient material, the resilient material being deformable in order to cause the movement of the reflector means.

14. An optical switch according to any one of the preceding claims and including a light source and diffusion means such that the light source illuminates the optical switch.

15. An optical switch according to any one of the preceding claims and including transmitter means and receiver means.

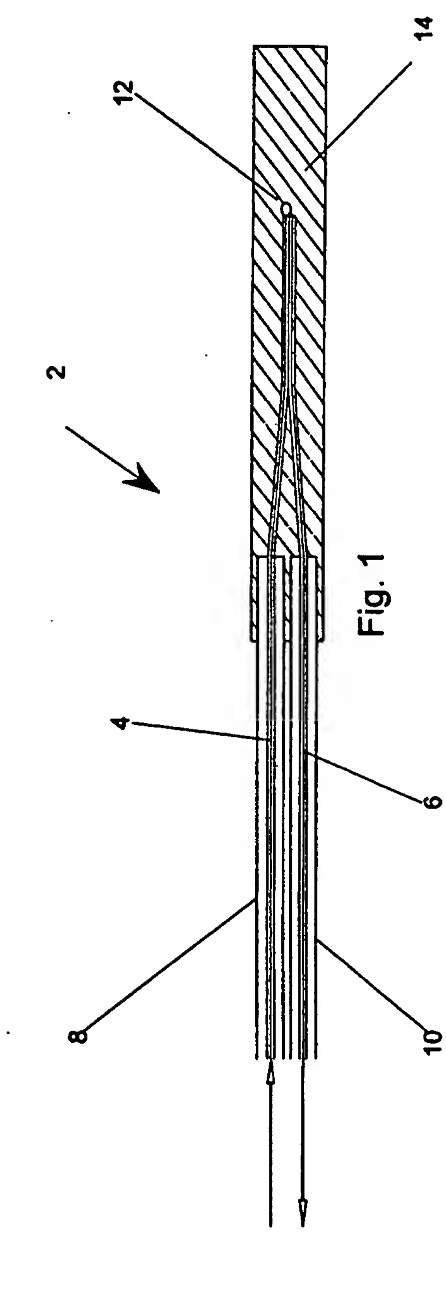


Fig. 1

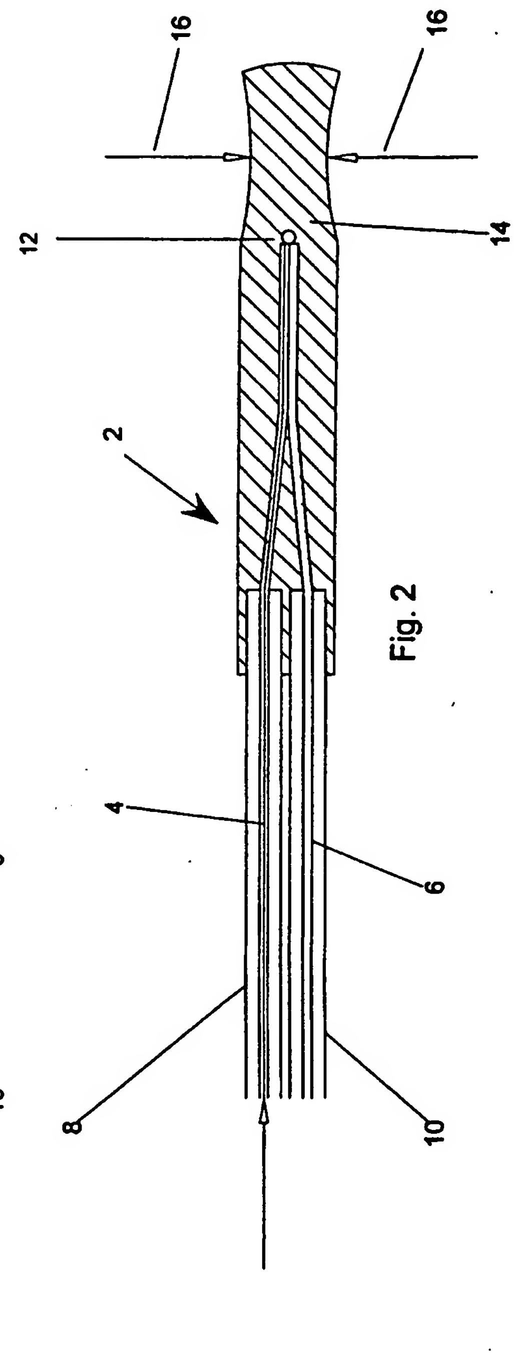


Fig. 2

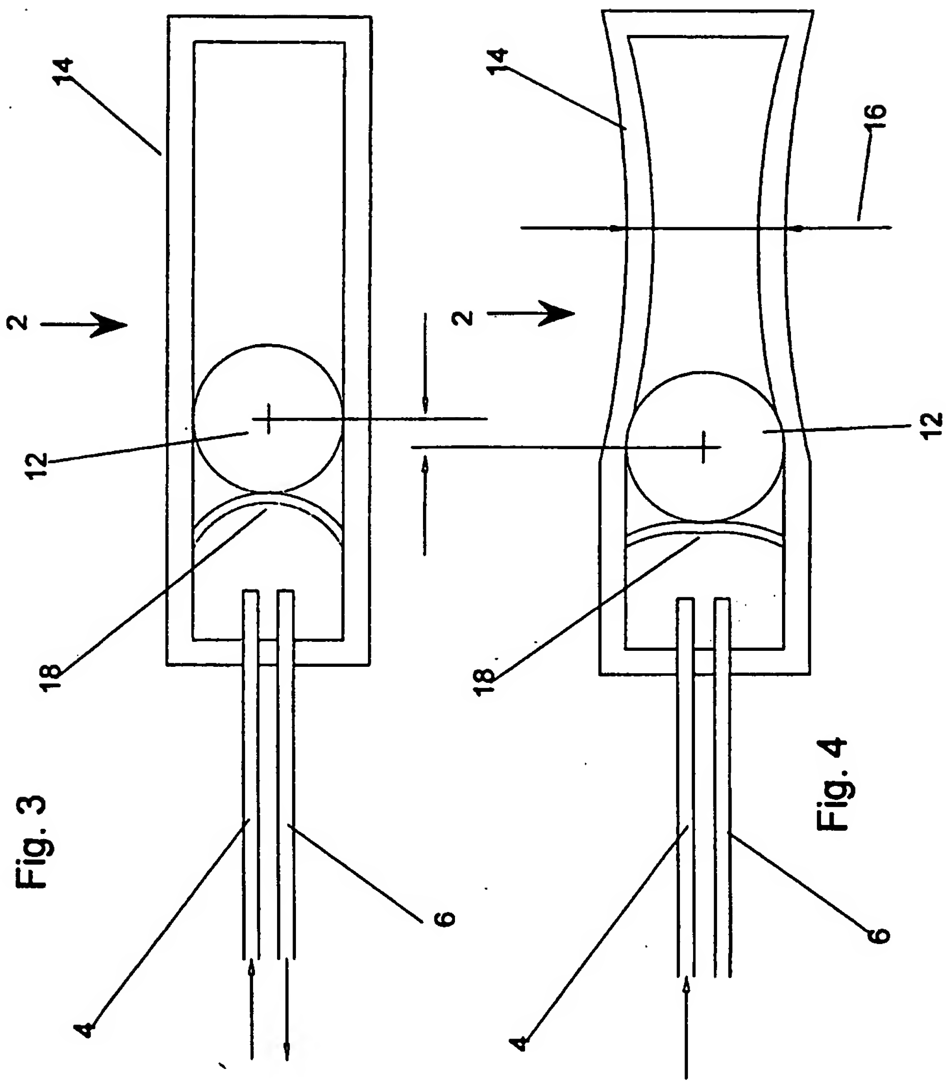
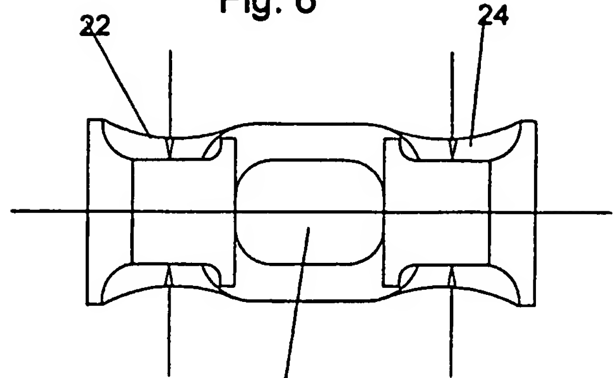
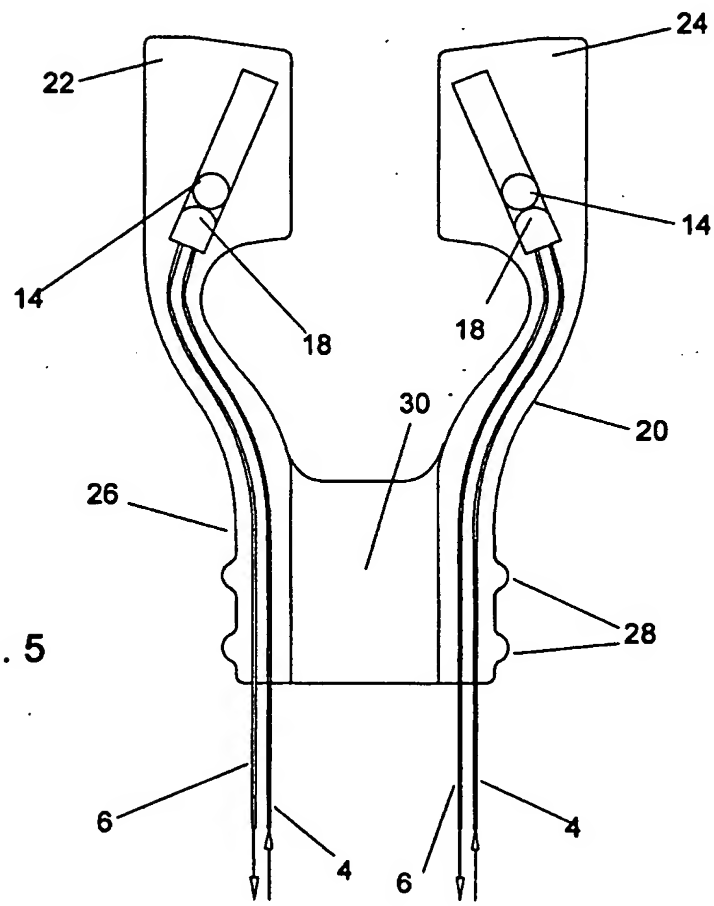


Fig. 3

Fig. 4

Fig. 6





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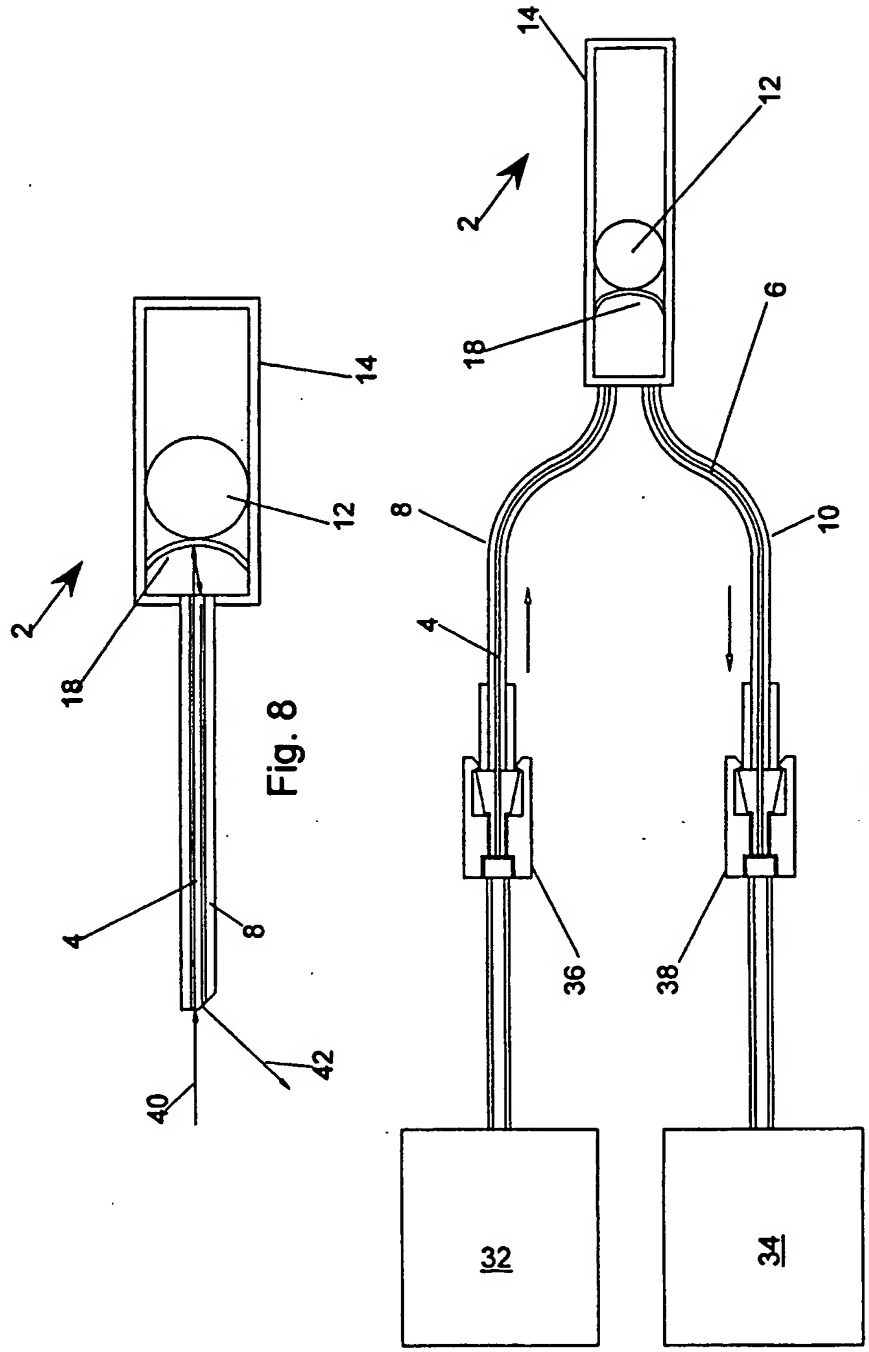

Fig. 8

Fig. 7

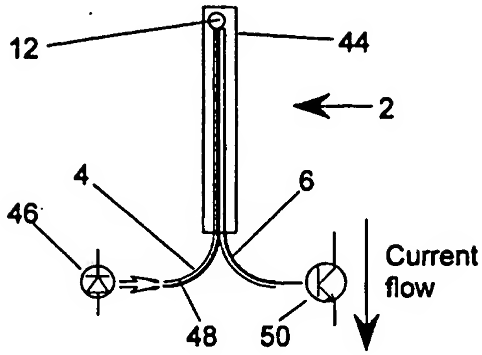

Fig 9

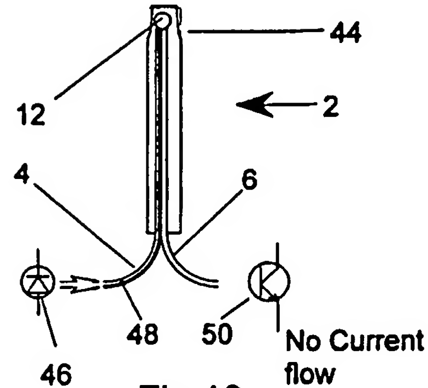

Fig 10

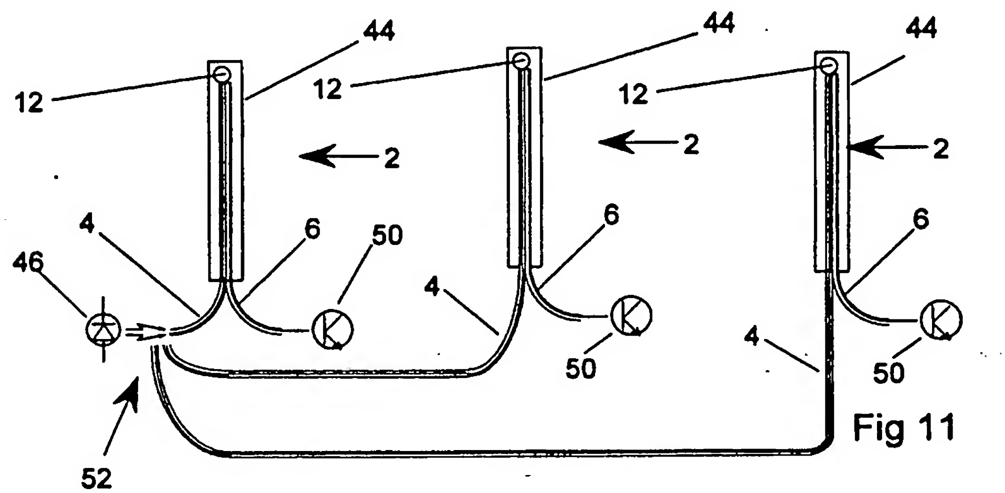

Fig 11

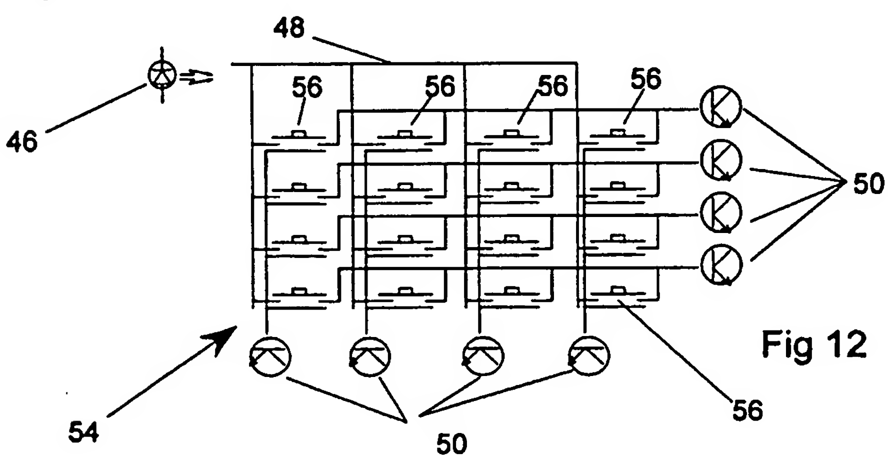

Fig 12

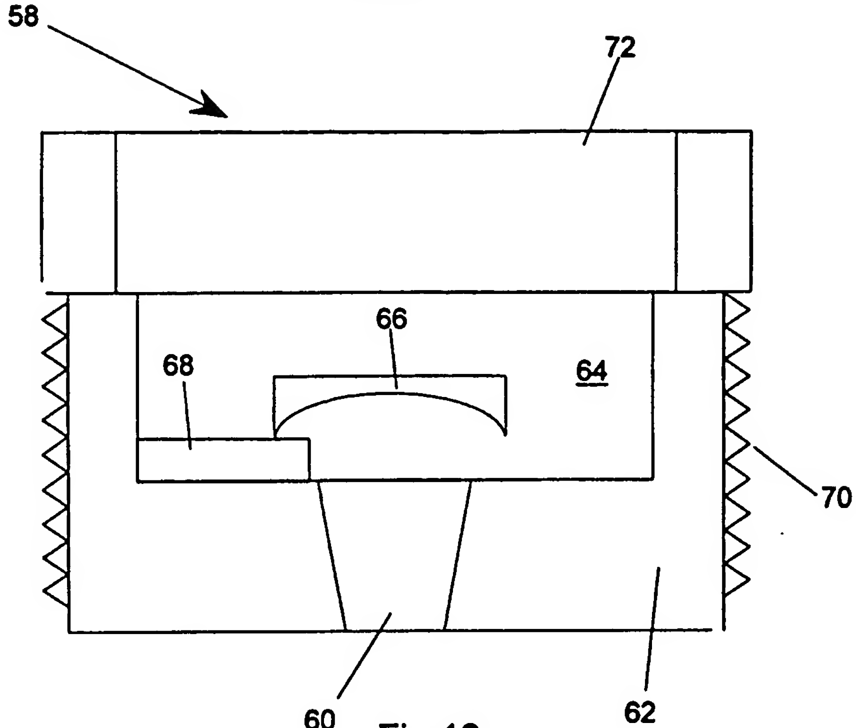

Fig 13

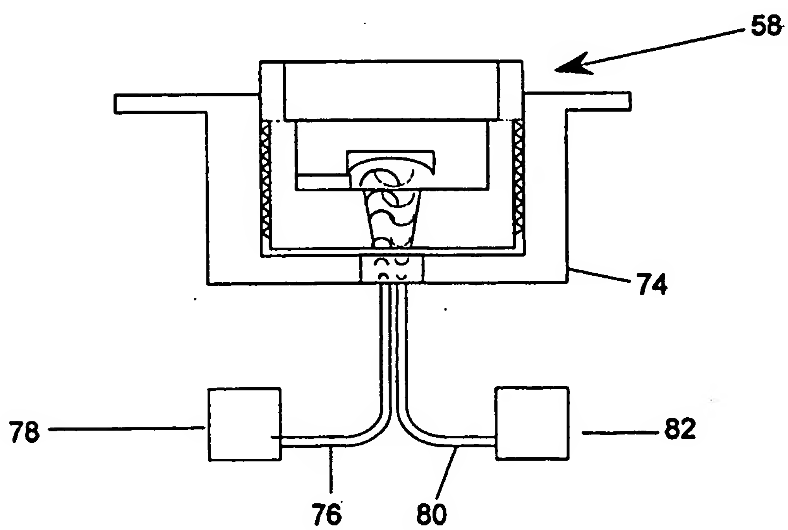

Fig 14

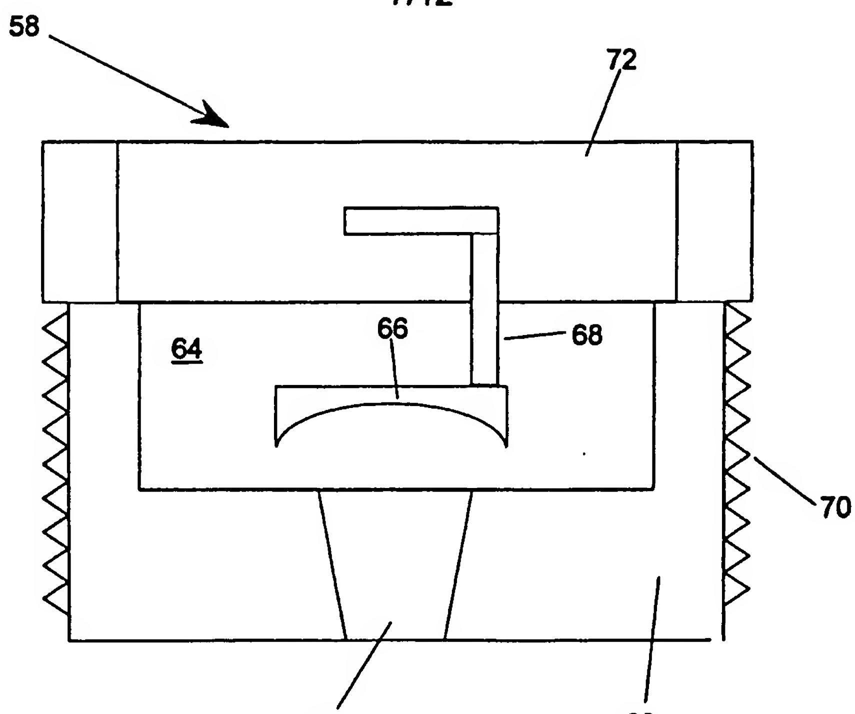

Fig 15

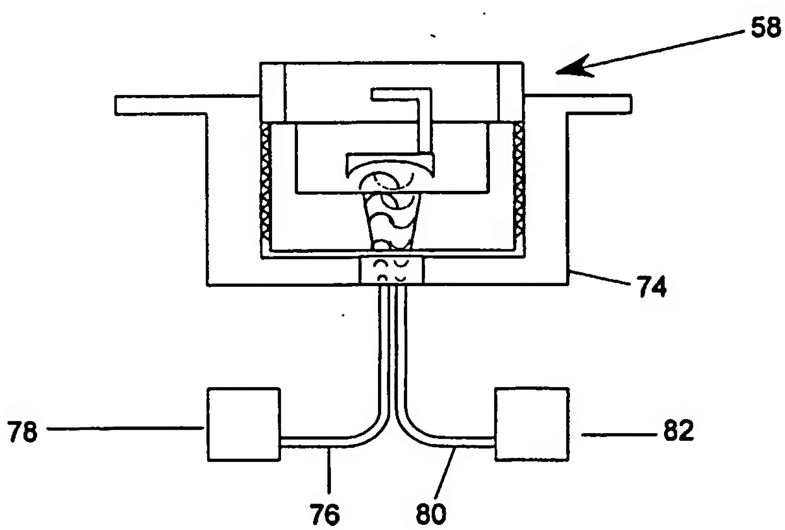

Fig 16

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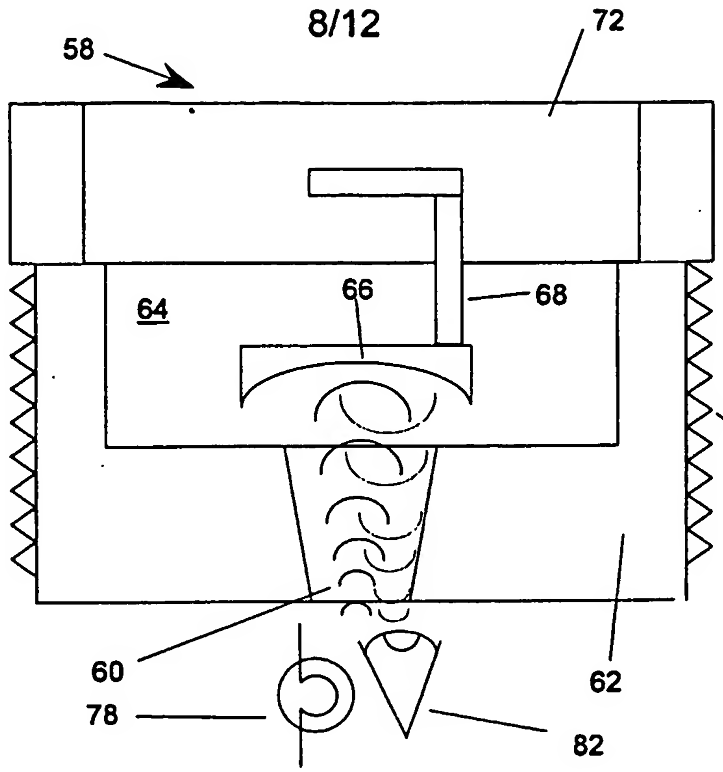


Fig 17

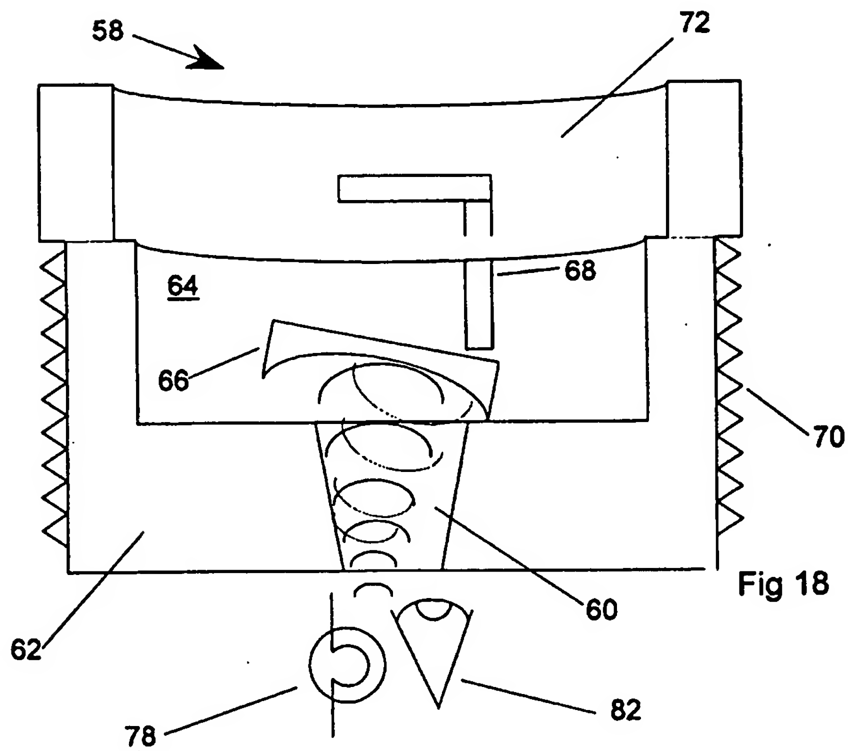


Fig 18

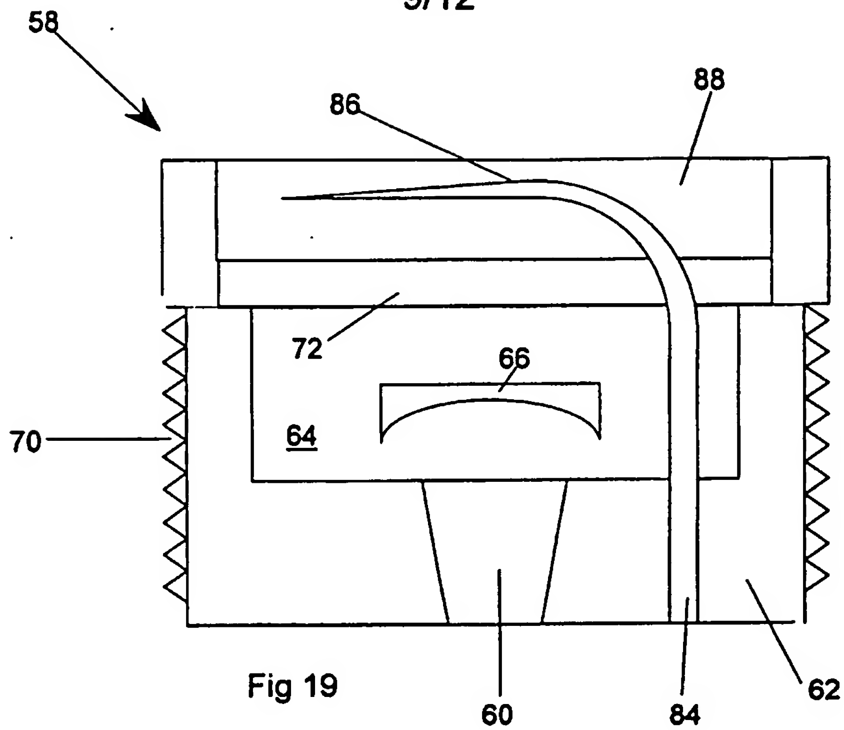
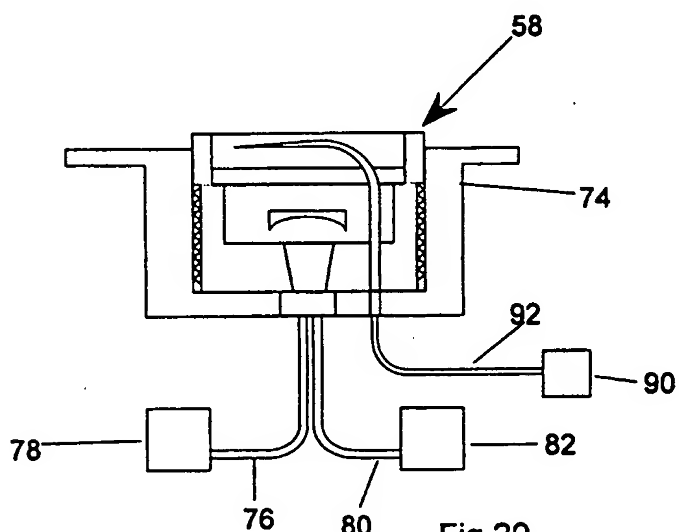


Fig 19



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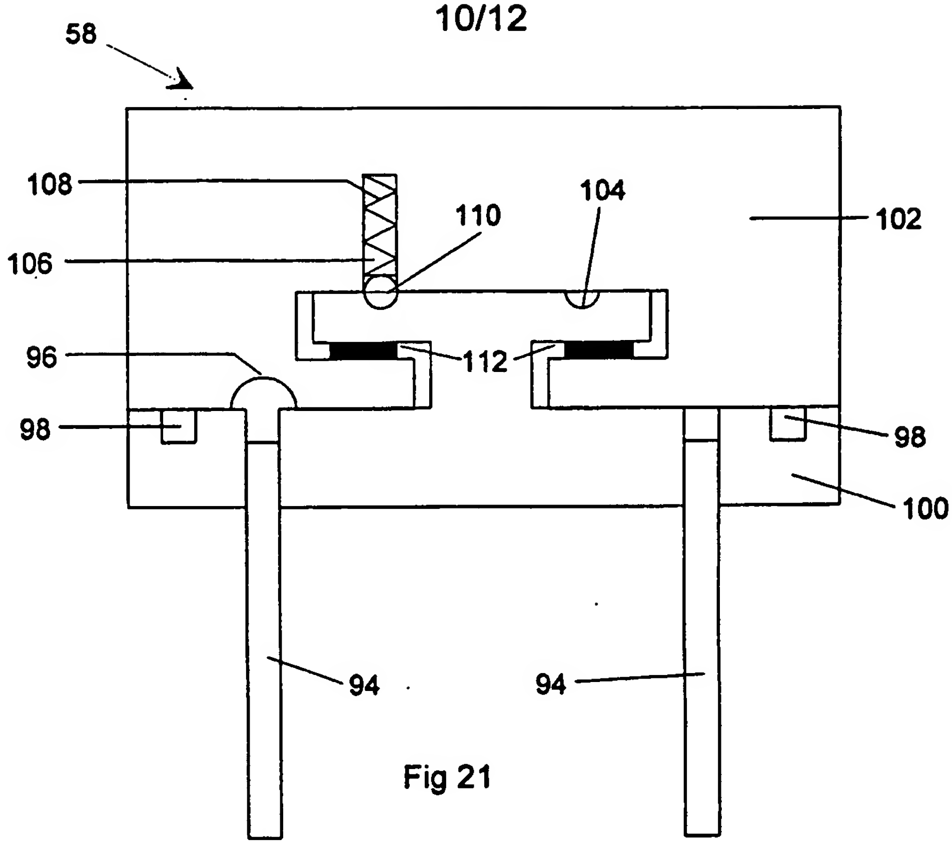

Fig 21

Fig 22

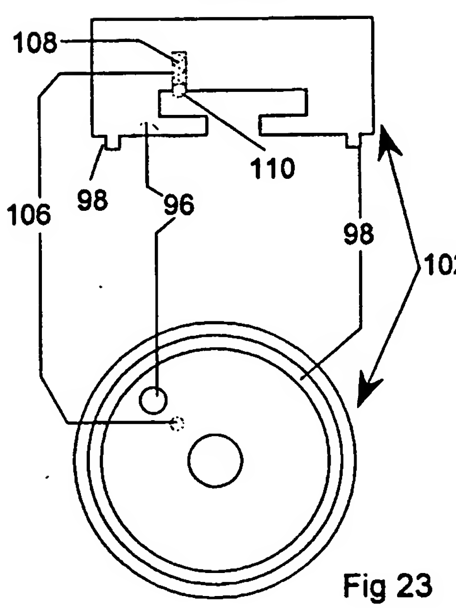

Fig 23

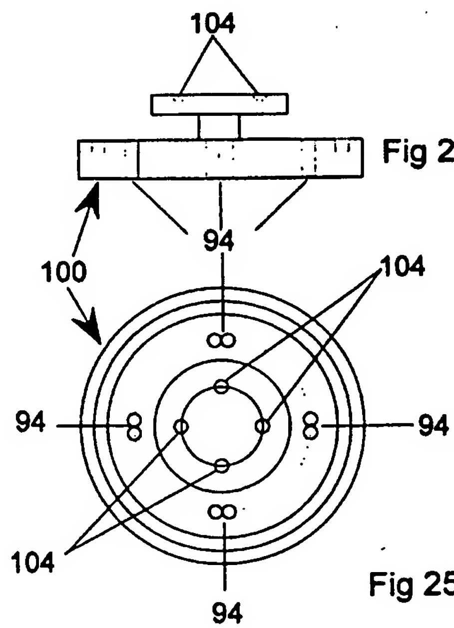

Fig 24

Fig 25

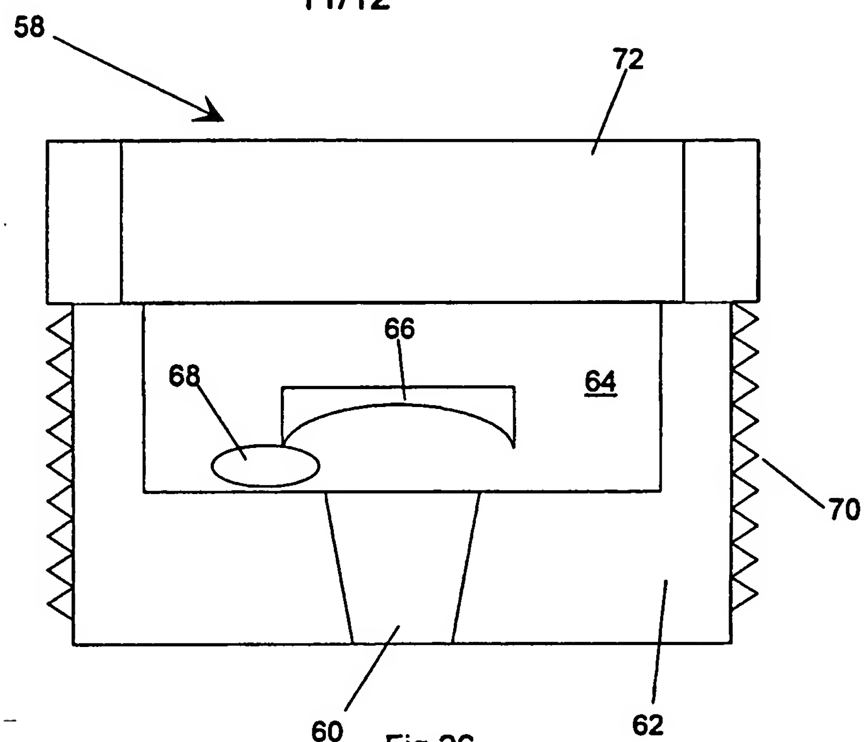

Fig 26

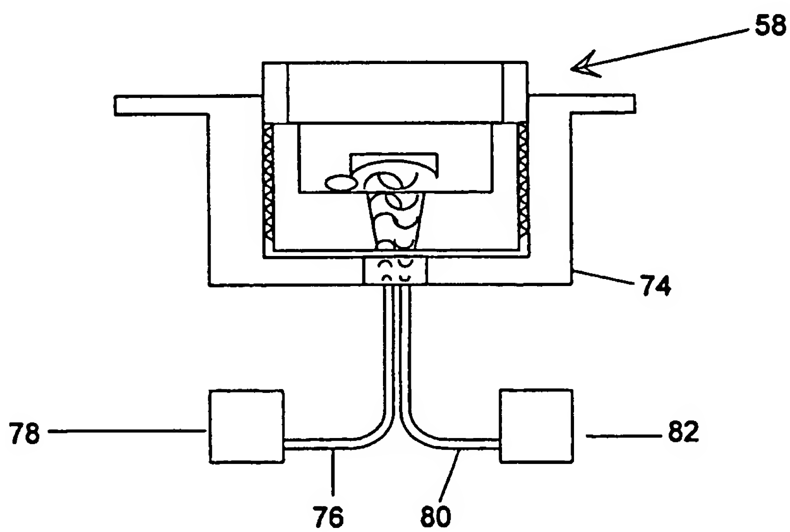

Fig 27

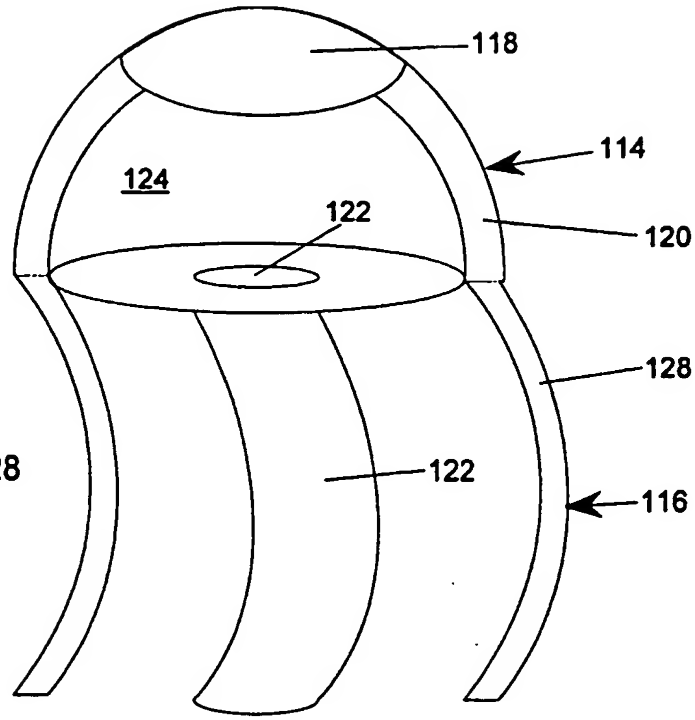
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Fig. 28

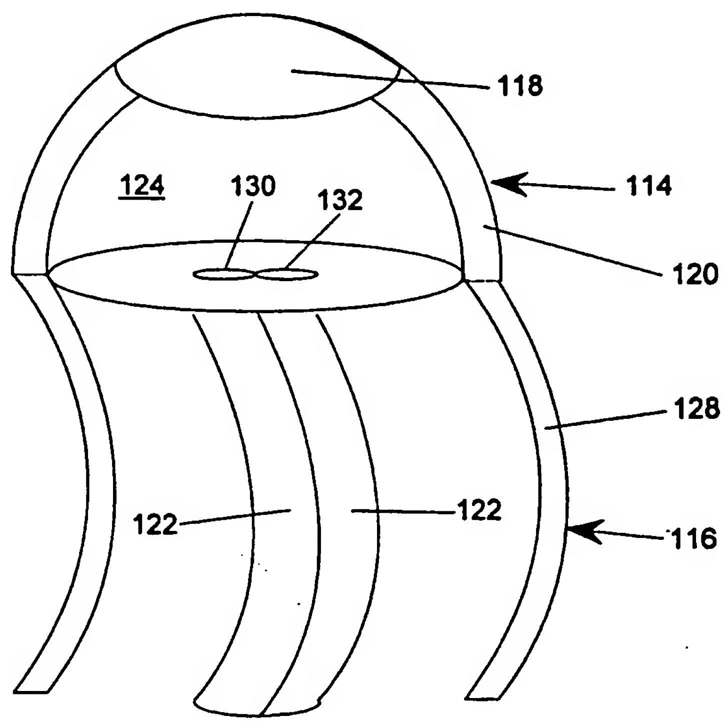
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Fig. 29

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 95/00781

A. CLASSIFICATION OF SUBJECT MATTER

H 03 K 17/968,G 02 B 26/02,G 02 B 26/08

According to International Patent Classification (IPC) or to both national classification and IPC 6

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H 03 K,G 02 B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 5 222 165 (BOHLINGER) 22 June 1993 (22.06.93), totality.	1-3,6, 8,9, 13
A		4,5
X	DE, A, 3 524 492 (SIEMENS) 15 January 1987 (15.01.87), totality.	1-4,6, 8,9, 12,13
A		5,7,14
X	DE, A, 3 700 856 (TELEFUNKEN) 28 July 1988 (28.07.88), column 9, line 59 - column 10, line 37; fig. 14,15.	1,6, 12,13, 15
A		2,3

[X] Further documents are listed in the continuation of box C.

[ ] Patent family members are listed in annex.

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Date of the actual completion of the international search 31 May 1995	Date of mailing of the international search report 18.07.95
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Authorized officer FELLNER e.h.

International Application No
PCT/GB 95/00781

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	--	
X	US, A, 4 607 161 (ANDERSON et al.) 19 August 1986 (19.08.86), abstract; figs..	1, 6-8, 10,12, 13
	--	
X	US, A, 5 199 088 (MAGEL) 30 March 1993 (30.03.93), abstract; figs..	1,6,8, 9,12
A		5

ANHANG — ANNEX — ANNEXE

zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

to the International Search Report to the International Patent Application No.

au rapport de recherche international relatif à la demande de brevet international n°

PCT/GB 95/00781 SAE 107171

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentdokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

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Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
US A 5222165	22-06-93	keine - none - rien	
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